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Article

Early-life predictors of retirement decisions and post-retirement health

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A R T I C L E I N F O

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A B S T R A C T

It remains unclear whether retirement circumstances are associated with better or worse post-retirement health. This is partly due to confounding between measures of retirement circumstances and a tendency to account only for covariates around retirement age. The present study examined the contributions of both retirement age and retirement type, independently, to post-retirement health around age 77 years. It also examined whether these contributions remain once earlier life-course factors – social class, cognitive ability and education – were accounted for. Our sample was 742 Scottish people who took part in the Scottish Mental Survey 1947. In a path model including life-course predictors, retirement type (reason), but not age, significantly predicted post-retirement health, with ill-health retirement associated with poorer physical ($\beta = 0.455$, 95% CI [0.313, 0.597], $p < 0.001$) and mental health ($\beta = 0.339$, 95% CI [0.191, 0.486], $p < 0.001$), and redundancy retirement associated with poorer physical health only ($\beta = 0.200$, 95% CI [0.069, 0.331], $p = 0.004$). Of the life-course predictors, higher adult social class was associated with later retirement ($\beta = 0.115$, 95% CI [0.034, 0.196], $p = 0.006$) and higher childhood cognitive ability was associated with increased odds of voluntary retirement (OR = 1.054, 95% CI [1.005, 1.105], $p = 0.032$), but no indirect contribution to health (mediated by retirement circumstances) was significant. At the same time, higher childhood cognitive ability directly predicted better post-retirement physical health ($\beta = -0.110$, 95% CI [-0.216, -0.004], $p = 0.041$), independently of retirement circumstances. This study demonstrates the importance of considering retirement circumstances beyond age, and of accounting for confounding between retirement circumstances and earlier life-course factors.

Introduction

A great deal of research has been devoted to examining the association between retirement and subsequent health. However, there is little consensus between such studies with some reporting that retirement benefits health (e.g., Westerlund, Kivimäki, Singh-Manoux, Melchior, Ferrie, Pentti, et al., 2009; Mein, Martikainen, Hemingway, Stansfeld, & Marmot, 2003; Hessel, 2016), detriments health (e.g., Calvo, Sarkisian, & Tamborini, 2013), or has no significant association with later health (e.g., Hyde, Ferrie, Higgs, Mein, & Nazroo, 2004; Di Gessa, Corna, Platts, Worts, McDonough, Sacker, et al., 2017). Furthermore, several studies have noted significant associations between retirement and health that are weakened and, in some cases, attenuated once proximal pre-retirement circumstances – such as socioeconomic circumstances or health – are accounted for (e.g., Di Gessa et al., 2017; Hyde et al., 2004). The nature and independence of the contribution of retirement circumstances to subsequent health is therefore unclear.

Attenuation of the retirement-health association may not be limited to proximal circumstances; factors from much earlier in life have been shown to have important contributions to later-life economic activity and health. In particular, better socioeconomic circumstances, cognitive ability and education in early life have been associated with higher odds of being economically active around retirement age (Iveson, Dibben & Deary, *accepted a*; Fahy et al., 2017) and with better physical and mental health in older age (e.g., Iveson, Dibben & Deary, *under review b*; Hagger-Johnson, Shickle, Deary, & Roberts, 2010; Smith, Anderson, Salinas, Horvatek, & Baker, 2015). The importance of early-life advantage is thought to represent, among other mechanisms, its role in building human capital (Kanfer, Wanberg, & Kantrowitz, 2001; Sterns & Dawson, 2012) – the skills and attributes necessary for being economically active – resilience to morbidity (e.g., Stern, 2009), and healthy behaviours (e.g., Hagger-Johnson et al., 2010). Given their associations with both economic activity and health in later life, and their temporal distance to retirement circumstances, early life factors may help to elucidate the nature of the retirement-health association.

In addition to considering underlying factors, it is increasingly clear

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that the nature of the association between retirement and subsequent health is affected by the timing and the type of – or reasons for – retirement experienced (e.g., Loretto & Vickerstaff, 2013). By retirement timing we refer to the age at which individuals retire. By retirement type we refer to whether retirement was voluntary or involuntary, where involuntary retirement can be due to individual factors such as ill-health or by external factors such as redundancy (e.g., Hyde et al., 2004; McNair, Flynn, Owen, Humphreys, & Woodfield, 2004). Previous studies of post-retirement health have often confounded the timing and type of retirement. Studies examining retirement age have commonly interpreted this as relative to the state pension age of the sample without considering why individuals retire earlier or later (e.g., Westerlund, Vahtera, Ferrie, Singh-Manoux, Pentti, Melchior, et al., 2010; Calvo et al., 2013; Di Gessa et al., 2017; Virtanen, Oksanen, Pentti, Ervasti, Head, Stenholm, et al., 2017). On the other hand, studies examining type of retirement have often ignored the age at which individuals retire, for example referring to 'voluntary early retirement' without consideration of voluntary late retirement (e.g., Hyde et al., 2004; Jokela, Ferrie, Gimeno, Chandola, Shipley, Head, et al., 2010). Separating the timing and type of retirement may help to better assess the associations between retirement and health, and to better understand any attenuation resulting from accounting for pre-retirement circumstances.

In the present study, we investigate these issues in a cohort of Scottish individuals born in 1936. We first establish the associations between early-life socioeconomic circumstances, early-life cognitive ability, education, and more proximal (pre-retirement) socioeconomic circumstances and retirement status, age and type. We then investigate the structure underlying associations between life-course factors, retirement circumstances, and later-life health. By examining both direct and mediated associations, we investigate the potential role of pre-retirement circumstances as common causes, the contribution of retirement circumstances to health independently of prior circumstances, and the potential role of retirement circumstances as mediators of the association between pre-retirement factors and later-life health. As evidence from the Whitehall II study has suggested that the effect of retirement is different for physical and mental health (Mein et al., 2003), we investigate associations with post-retirement physical and mental health separately. In doing so, we assess whether the associations between retirement circumstances and poorer subsequent health remain once pre-retirement factors are accounted for.

Methods

Sample

The analytic sample consisted of 742 individuals, born in Scotland in 1936, who took part in the Scottish Mental Survey 1947 (Scottish Council for Research in Education, 1949). On the 4th of June 1947 almost all age-11 children attending a Scottish school completed a test of general cognitive ability – the Moray House Test No. 12 (MHT). Various samples of individuals were followed-up into later life, including both the 6-Day Sample and the 36-Day Sample cohorts (see Deary, Whalley, & Starr, 2009, pp. 16–40) who were followed-up in a project that ran between 2011 and 2016 (Brett & Deary, 2014; Deary & Brett, 2015). These two cohorts have been combined for the present sample due to the similarity in available measures. These individuals completed a postal questionnaire at the first later-life follow-up (2012 for the 6-Day Sample, 2014 for the 36-Day Sample) and a telephone interview at the second later-life follow-up (2013 for the 6-Day Sample, 2015 for the 36-Day Sample).

The sample and its cleaning process are shown in Fig. 1. Of the 6292 individuals in the combined 6-Day and 36-Day samples, 1767 individuals died and 1548 individuals were untraceable by the time of the later-life follow-up. A further 1555 individuals did not respond to the invitation to participate in the follow-up study: 64 individuals due to death or emigration and 1491 due to lack of interest. We then proceeded to remove individuals with missing retirement variables: 514 individuals refused to participate in any follow-up, 132 individuals participated but had missing retirement status, 1 individual was retired but was missing retirement age, and 33 individuals reported a retirement age of 30 or under. This resulted in an analytic sample of 742 individuals.

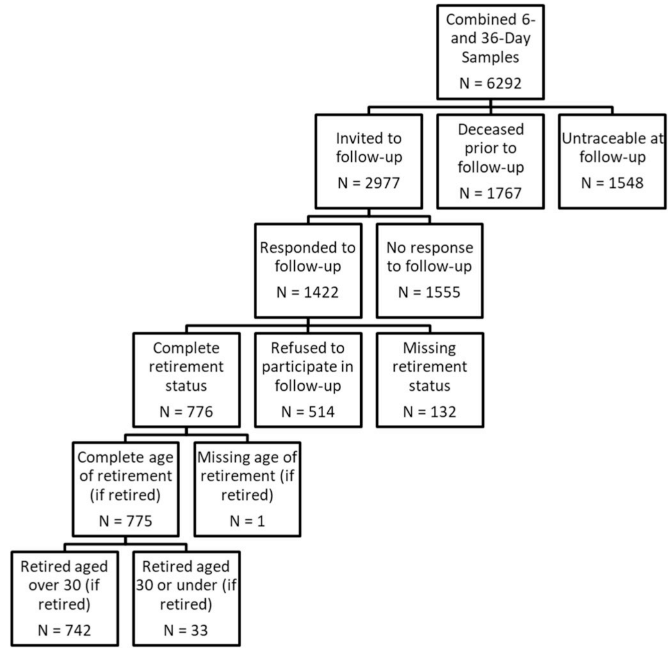

Fig. 1. Selection of analytic sample. The final sample consisted of individuals whom provided valid measures of retirement status, valid age of retirement (if retired) and age of retirement over 30 (for those retired).

Measures

Childhood occupational social class

Childhood socioeconomic circumstances were measured using the occupational social class of the father taken in 1947 (Scottish Council for Research in Education, 1949). Occupations were categorised into 5 occupational social classes using the 1950 United Kingdom occupational classification index (General Register Office, 1956). The order of classes was reversed so that higher classes indicated more professional occupations: 1) Unskilled, 2) Partly-skilled, 3) Skilled, 4) Managerial, 5) Professional.

Childhood cognitive ability

Childhood cognitive ability at age 11 was measured using the MHT in 1947 (Scottish Council for Research in Education, 1949). This paper-and-pencil test consisted of a series of problem-solving and reasoning questions, with a possible maximum score of 76 (minimum = 0). MHT scores correlate strongly with scores on other tests of general cognitive ability (correlation coefficient of around 0.8 with Terman-Merrill revision of the Binet test; Matthews, Power, & Stansfeld, 2001). For the sample description, raw MHT scores were used. For further analyses, we used standardised residuals estimated by regressing MHT raw scores on age at test. This was done to account for age-related variation in MHT scores.

Education

At the first later-life follow-up questionnaire (2012 for the 6-Day Sample, 2014 for the 36-Day Sample), individuals reported the number of completed years spent in full-time education, including school and post-school education.

Adult occupational social class

Adult socioeconomic circumstances were measured using the individual's own occupational social class. Occupations reported at the first later-life follow-up questionnaire (2012 for the 6-Day Sample, 2014 for the 36-Day Sample) were initially categorised into 6 occupational social classes using the 1980 United Kingdom occupational classification index (Office of Population Censuses and Surveys, 1980). We then combined 'Skilled Manual' occupations and 'Skilled Non-manual' occupations into a single 'Skilled' category for harmony with earlier classification indexes. The order of classes was reversed so that higher classes indicated more professional occupations: 1) Unskilled, 2) Partly-skilled, 3) Skilled, 4) Managerial, 5) Professional.

Retirement age and type

Retirement status and age in years (for those retired) was self-reported as part of the first later-life follow-up questionnaire (2012 for the 6-Day Sample, 2014 for the 36-Day Sample). Participants were asked "Are you currently retired from paid work?" and "If so, what age were you when you retired?". Notably, this resulted in a single retirement event (even if individuals had transitioned to part-time working etc.). Participants were then asked "What was your main reason for retirement?" with retirement reasons categorised as either 'Statutory or Voluntary Retirement' (i.e., those who chose to retire, regardless of timing), 'Retirement due to ill health' (i.e., those who were unable to continue working due to poor health), 'Retirement due to redundancy' (i.e., those who were made redundant and subsequently left the workforce) and 'Retirement due to other circumstances'.

Post-retirement health

Post-retirement health was reported during both the first, questionnaire-based follow-up (2012 for the 6-Day Sample, 2014 for the 36-Day Sample) and the second, telephone-based follow-up (2013 for the 6-Day Sample, 2015 for the 36-Day Sample). As part of the questionnaire-based follow-up, the RAND Short-Form 36-item Health Survey (SF-36; Ware & Sherbourne, 1992; Ware, 2000) was administered, in which participants are required to rate various aspects of their health. Physical Functioning and Mental Health subscale scores were calculated (Ware, 2000). All other measures of later-life health were administered by trained researchers as part of the second, telephone-based follow-up. A telephone-based version of the Townsend Disability Scale was administered (Townsend, 1962), with total scores being used along with reversed SF-36 Physical Functioning subscale scores to indicate poorer physical health. Participants also completed a telephone-based version of the Hospital Anxiety and Depression Scale (HADS; Zigmond & Snaith, 1983). Anxiety and Depressions subscale scores were calculated and were used along with reversed SF-36 Mental Health subscale scores to indicate poorer mental health.

Statistical analysis

The analysis had two stages. In the first stage, survival analysis was conducted using Cox proportional hazards regression to assess predictors of retirement risk. Individuals were censored at the date of the first later-life follow-up questionnaire (2014). Survival time was calculated as the number of years between birth and retirement or censoring, as appropriate. For those reporting retirement type (N = 573), multinomial logistic regression was used to assess the associations between life-course predictors and the type of retirement experienced.

In the second stage, a path model was constructed for retired individuals (N = 739) using childhood occupational social class (reversed), childhood cognitive ability (standardised residuals from age-adjusted MHT scores), full-time education, adult occupational social class (reversed), retirement age, retirement type, and both physical and mental health latent variables. Physical health was indicated by SF-36 Physical Functioning scores (reversed such that higher scores indicated poorer health and t-scaled; M = 50 and SD = 10) and Townsend Disability scores (t-scaled) and mental health was indicated by SF-36 Mental Health scores (reversed and t-scaled), HADS Anxiety scores and HADS Depression scores (each t-scaled). Notably, indicators were coded such that higher scores represented poorer health. In estimating the latent variables, the loadings of SF-36 Physical Functioning score on the Physical Health latent variable and SF-36 Mental Health score on the Mental Health latent variable were fixed to 1. Measures were entered in temporal order, such that the association between earlier-measured variables and post-retirement health could be mediated by later-measured variables.

Table 1
Descriptive statistics for the analytic sample (N = 742).

	N/Mean	SD	N Missing
Sex (N)			0
Male	389		
Female	353		
Father's Occupational Social Class (reversed) (max = 5)	2.73	0.93	14
Moray House Test score (max = 76)	45.25	13.04	53
Years of full-time education	11.27	2.49	1
Adult Occupational Social Class (reversed) (max = 5)	3.53	0.87	158
Retirement status at follow-up (N)			0
Retired	739		
Not Retired	3		
Retirement age (years)			
Overall	60.85	5.70	3
Voluntary	61.47	4.56	
Ill Health	58.61	6.31	
Redundancy	58.13	5.39	
Other	61.64	9.34	
Retirement type			169
Voluntary	389		
Ill Health	75		
Redundancy	57		
Other	52		
SF-36 Physical Functioning score (max = 100)	65.61	28.71	87
Townsend score (max = 18)	1.33	2.24	397
SF-36 Mental Health score (max = 100)	81.18	14.20	91
HADS Anxiety score (max = 21)	3.81	3.02	397
HADS Depression score (max = 21)	2.41	1.93	397

MHT score = Moray House Test score; SF-36 = RAND Short-form 36-item Health Survey; HADS = Hospital Anxiety and Depression Scale.

Results

Sample description

Summary statistics for the analytic sample, including the number of missing cases in each key variable, are shown in Table 1. Correlations between variables are shown in Supplementary Material.

We compared the retained sample to individuals removed during the sample refinement process in order to assess selection (see Fig. 1). Descriptives for the full sample as well as the retained and removed individuals at each stage of the sample refinement process are shown in Supplementary Material. Individuals invited to follow-up demonstrated significantly higher childhood social class ($p < 0.001$) and childhood cognitive ability ($p < 0.001$) than those not invited to follow-up. Similarly, those who responded to the invitation demonstrated significantly higher childhood social class ($p < 0.001$) and childhood cognitive ability ($p < 0.001$) than those who did not respond. Individuals who participated and had complete retirement status had significantly higher childhood social class ($p < 0.001$) and childhood cognitive ability ($p < 0.001$) than those who either refused to participate or otherwise had missing retirement status at follow-up. As only 1 individual was removed due to missing retirement age we were unable to make statistical comparisons for this stage of the sample selection. However, individuals removed for retiring at or below age 30 years did not significantly differ to those retained in terms of childhood social class ($p = 0.495$), childhood cognitive ability ($p = 0.673$), years of full-time education ($p = 0.084$), adult social class ($p = 0.452$), physical health (SF-36 Physical Functioning: $p = 0.840$; Townsend: $p = 0.886$) or mental health (SF-36 Mental Health: $p = 0.394$; HADS Anxiety: $p = 0.364$; HADS Depression: $p = 0.807$).

In terms of retirement circumstances, only 3 individuals in the analytic sample had not retired from work by the time of the later-life follow-up (around age 77). For those retired, the age of retirement ranged from 32 years-old to 78 years-old. The age of retirement significantly differed by sex ($X^2 = 106.64$, df = 40, $p < 0.001$), such that on average men (M = 62.03, SD = 5.46) retired later than women (M = 59.55, SD = 5.69). This is perhaps unsurprising given that statutory retirement age for this cohort differed by sex, with women reaching statutory retirement age at age 60 and men reaching statutory retirement age at age 65. Voluntary retirement (including statutory retirement) accounted for the majority of individuals' reasons for retiring. Retirement age significantly differed between the retirement types ($F(3, 569) = 10.86$, $p < 0.001$), with those retiring due to ill-health (M = 58.61, SD = 6.31) or redundancy (M = 58.13, SD = 5.39) retiring earlier than those retiring voluntarily (M = 61.47, SD = 4.56) or for other reasons (M = 61.64, SD = 9.34). Notably, there was also a significant sex difference in retirement reason ($X^2 = 9.33$, df = 3, $p = 0.025$), driven by significantly more males (N = 50) than females (N = 25) retiring due to ill-health ($X^2 = 8.33$, df = 1, $p = 0.004$). There was no significant sex difference in either voluntary retirement (Male N = 205, Female N = 184; $p = 0.287$), redundancy retirement (Male N = 33, Female N = 24; $p = 0.233$) or other retirement (Male N = 21, Female N = 31; $p = 0.166$) types.

In terms of later-life health (Table 1), the analytic sample reported relatively good physical health (high SF-36 Physical Functioning scores) and relatively little disability (low Townsend scores). Similarly, the sample overall reported relatively good mental health (high SF-36 Mental health scores) and relatively little anxiety and depression (low HADS scores). Again, many of the individuals removed from the sample during cleaning died prior to follow-up, suggesting selective drop-out of the most ill individuals.

Associations with retirement circumstances

Age of retirement

For the age of retirement survival analyses, we first examined the contribution of sex to the retirement hazard over time. Being female was associated with a 50% increase in retirement risk versus being male

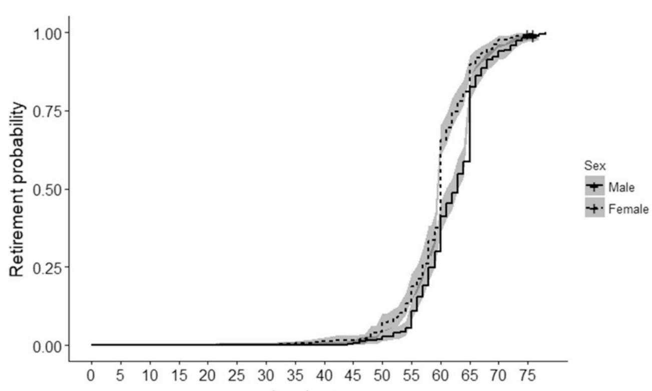

Fig. 2. Kaplan-Meier survival curves showing retirement probability for males (solid line) and females (dashed line). Shaded areas represent 95% confidence intervals. The large jump in retirement probability among females around age 60 and among males around age 65 represents the contribution of their respective statutory retirement age.

(HR = 1.493, 95% CI [1.290, 1.728], $p < 0.001$; see Fig. 2). These large sex differences likely represent, at least in part, the different statutory retirement age for males (age 65) and females (age 60) in this sample. Due to these sex differences, we stratified by sex or adjusted for the contribution of sex in all subsequent analyses.

Table 2 shows the hazard ratios associated with each of the life-course predictors and retirement. In the first analysis, we calculated the hazard ratios of father's social class (reversed), childhood cognitive ability (standardised residuals from age-adjusted MHT scores), years of full-time education and own social class (reversed) individually. In the second analysis, each model was further stratified by sex. In the third analysis, we calculated the hazard ratio of each predictor mutually-adjusted for other predictors and stratified by sex. The only life-course predictor which was significantly associated with retirement was adult social class, with a single level advantage (i.e., more professional classes) predicting a 12% increase in retirement risk, even when stratified by sex. However, once adjusted for all other predictors (father's social class, childhood cognitive ability and education, and stratified by sex), the direction of this association reversed, with a single level advantage in adult social class predicting a 13% decrease in retirement risk. Given the reversal of the association between adult social class and retirement risk, we examined whether the inclusion of other life-course factors in the model strengthened this association by accounting for the residuals of the simpler model rather than due to their own association with retirement risk (i.e., a suppression effect). By adding other life-course predictors individually to the survival model including adult social class and sex, we observed a suppression effect of childhood social class ($r_{part} = 0.077$, $r = -0.047$) and years of education ($r_{part} = 0.077$, $r = -0.020$), as indicated by larger absolute part correlations with retirement age than zero-order correlations, but not of childhood cognitive ability ($r_{part} = 0.045$, $r = -0.051$). No other life-course predictors were significantly associated with retirement risk, either individually or after mutual-adjustment. Sensitivity analyses using linear regression, in which retirement age was entered as a continuous outcome variable, demonstrated very similar results (See Supplementary Material). In this analysis, own adult social class was the only life-course predictor significantly associated with retirement age, and a single level advantage was associated with later retirement (B = 0.706, 95% CI [0.121, 1.291], $p = 0.018$).

Type of retirement

Table 3 shows the univariate, sex-adjusted and mutually-adjusted associations between each life-course predictor and the odds of a given type of retirement versus all other types of retirement. Descriptive statistics split by type of retirement are shown in Supplementary Material.

After adjustment for sex and other life-course factors, a 1 SD advantage in childhood cognitive ability significantly predicted increased odds of voluntary retirement. No other life-course factors significantly predicted voluntary retirement odds once adjusted for sex and other life-course factors. The odds of ill-health retirement and redundancy retirement were significantly predicted by specific life-course factors in the univariate and sex-adjusted models, but not after mutual adjustment. As with retirement age, this indicates some degree of confounding between life-course factors for these retirement types.

Associations with later-life health

Univariate associations between each of the life-course or retirement factors and both physical and mental health outcomes are shown in Table 4 (see also Supplementary Material for correlations between predictors and health and descriptives of health by retirement type).

In terms of physical health, being female and retiring due to ill-health or redundancy were all associated with poorer health, indicated by higher reversed SF-36 Physical Functioning t-scores and by higher Townsend Disability t-scores. A 1 SD advantage in childhood cognitive

Table 2
Hazard Rations (HR) showing the retirement risk associated with childhood social class, childhood cognitive ability, years of education, and adult social class. Shown are the HRs associated with each predictor individually (univariate), stratified by sex, and then mutually-adjusted for all other predictors (also stratified by sex).

	Univariate		Stratified by sex		Mutually-adjusted	
	HR	p	HR	p	HR	p
Father's Occupational Social Class (reversed)	1.059 [0.984, 1.140]	0.128	1.056 [0.980, 1.137]	0.153	1.084 [0.990, 1.186]	0.082
Moray House Test score (standardised residuals)	1.065 [0.990, 1.145]	0.094	1.051 [0.975, 1.131]	0.194	1.030 [0.931, 1.139]	0.567
Years of full-time education	1.015 [0.987, 1.044]	0.310	1.022 [0.993, 1.051]	0.141	1.018 [0.981, 1.056]	0.337
Adult Occupational Social Class (reversed)	1.120 [1.021, 1.229]	0.017	1.106 [1.006, 1.216]	0.038	0.869 [0.782, 0.965]	0.008

ability, a 1 year advantage in education and a level advantage in adult social class were each significantly associated with better physical health as reported on the SF-36 Physical Functioning scale, but not with physical health on the Townsend scale. A 1-year later retirement age was associated with better physical health, but only as reported on the Townsend scale.

In terms of mental health, retiring due to ill health was significantly associated with poorer health on all 3 outcome measures. Being female was associated with significantly poorer mental health as reported on the SF-36 Mental Health scale and the HADS anxiety scale, but not on the HADS depression scale. A 1-year advantage in education, in contrast, was associated with significantly better mental health on the SF-36 Mental Health scale and HADS anxiety scale. Several factors were significantly associated with better mental health on the SF-36 Mental Health scale only, including a 1 SD advantage in childhood cognitive ability, a level advantage in adult social class, and a 1-year later age of retirement.

Path analyses

We then constructed a path model to test the association between life-course predictors, retirement circumstances (age and reason) and post-retirement health for all retired individuals in the sample (N = 739). We omitted the dummy variable for 'Other' reasons for retirement, as its inclusion prevented convergence of the path model and this was the smallest category of retirement type (N = 52). This meant that the final model was specified as shown in Supplementary Material.

Significant paths emerging from the model are shown in Fig. 3, with full model results shown in Supplementary Material. All indicator variables had high loadings on the appropriate health latent variable, with higher scores on the latent variables represented poorer health.

There were significant associations between life-course predictors, which basically form a transgenerational social mobility model: higher childhood cognitive ability was significantly predicted by a level advantage in childhood social class (β = 0.155, 95% CI [0.079, 0.231], $p < 0.001$), more education was significantly predicted by both a level advantage in childhood social class (β = 0.139, 95% CI [0.063, 0.215], $p < 0.001$) and a 1 SD advantage in childhood cognitive ability (β = 0.349, 95% CI [0.289, 0.410], $p < 0.001$), and higher adult social class was significantly predicted by both a 1 SD advantage in childhood cognitive ability (β = 0.216, 95% CI [0.115, 0.316], $p < 0.001$) and a year advantage in education (β = 0.188, 95% CI [0.110, 0.265], $p < 0.001$) but not by higher childhood social class (p = 0.313).

Retirement circumstances were predicted by earlier life-course factors, though many of these associations were attenuated relative to the univariate regression analyses. The only life-course factors significantly associated with retirement circumstances were childhood cognitive ability and adult social class. A 1 SD advantage in childhood cognitive ability was directly associated with increased odds of voluntary retirement (OR = 1.054, 95% CI [1.005, 1.105], p = 0.032), and a single level advantage in adult social class was directly associated with later retirement (β = 0.115, 95% CI [0.034, 0.196], p = 0.006). None of the life-course factors significantly directly predicted retirement due to ill-health (all ps > 0.152) or redundancy (all ps > 0.117).

Turning to the predictors of poor physical and mental health, both retirement circumstances and, to a lesser-extent, earlier life-course factors proved to be significantly associated. Poorer physical health was significantly predicted by retirement due to ill health (β = 0.455, 95% CI [0.313, 0.597], $p < 0.001$) and retirement due to redundancy (β = 0.200, 95% CI [0.069, 0.331], p = 0.004). Better physical health was significantly and directly predicted by higher childhood cognitive

Table 3
Odds ratios from univariate associations, associations adjusted for sex, and mutually-adjusted associations (including sex) between life-course predictors and dummy-coded retirement type (versus all other types of retirement).

		Univariate		Adjusted for sex		Mutually-adjusted	
		OR	p	OR	p	OR	p
Father's Occupational Social Class (reversed)	Voluntary	1.110 [0.916, 1.345]	0.285	1.107 [0.914, 1.342]	0.298	0.981 [0.797, 1.205]	0.853
	Ill Health	1.028 [0.788, 1.346]	0.842	1.038 [0.798, 1.358]	0.782	1.180 [0.889, 1.580]	0.258
	Redundancy	0.860 [0.641, 1.157]	0.315	0.864 [0.645, 1.162]	0.329	0.958 [0.702, 1.316]	0.788
	Other	0.866 [0.638, 1.181]	0.357	0.850 [0.622, 1.167]	0.310	0.868 [0.619, 1.225]	0.416
MHT score (standardised residuals)	Voluntary	1.362 [1.116, 1.666]	0.002	1.351 [1.105, 1.656]	0.003	1.268 [1.018, 1.582]	0.035
	Ill Health	0.756 [0.583, 0.985]	0.036	0.789 [0.608, 1.028]	0.075	0.817 [0.613, 1.094]	0.170
	Redundancy	0.729 [0.547, 0.979]	0.032	0.743 [0.557, 0.999]	0.046	0.848 [0.619, 1.173]	0.311
	Other	0.966 [0.702, 1.355]	0.834	0.908 [0.650, 1.292]	0.582	0.889 [0.612, 1.314]	0.544
Years of full-time education	Voluntary	1.103 [1.025, 1.196]	0.013	1.105 [1.027, 1.199]	0.011	1.060 [0.976, 1.159]	0.184
	Ill Health	0.938 [0.836, 1.035]	0.240	0.932 [0.831, 1.027]	0.189	0.948 [0.829, 1.060]	0.391
	Redundancy	0.862 [0.731, 0.984]	0.050	0.861 [0.730, 0.982]	0.047	0.911 [0.764, 1.046]	0.243
	Other	0.961 [0.842, 1.070]	0.511	0.968 [0.847, 1.080]	0.594	1.000 [0.862, 1.129]	0.996
Adult Occupational Social Class (reversed)	Voluntary	1.166 [0.954, 1.426]	0.134	1.182 [0.966, 1.448]	0.104	1.033 [0.824, 1.292]	0.780
	Ill Health	0.927 [0.705, 1.226]	0.590	0.887 [0.676, 1.170]	0.390	0.947 [0.701, 1.287]	0.728
	Redundancy	0.738 [0.545, 1.004]	0.051	0.728 [0.537, 0.990]	0.041	0.820 [0.589, 1.145]	0.241
	Other	1.040 [0.752, 1.454]	0.814	1.099 [0.784, 1.567]	0.592	1.311 [0.885, 1.988]	0.188

Table 4
Univariate associations between sex, life-course predictors, retirement circumstances and physical and mental health outcomes. Note that physical and mental health outcomes are t-scored (M = 50, SD = 10) such that higher scores indicate poorer health.

	Physical Health				Mental Health	
	SF-36 Physical Functioning score (reversed)		Townsend Disability Scale score		SF-36 Mental Health score (reversed)	
	B	p	B	P	B	p
Sex						
Male (ref.)						
Female	2.420 [0.902, 3.939]	0.002	4.632 [2.548, 6.715]	< 0.001	1.986 [0.448, 3.523]	0.012
Father's Occupational Social Class (reversed)	-0.271 [-1.093, 0.550]	0.517	-0.809 [-1.996, 0.377]	0.180	-0.061 [-0.867, 0.806]	0.943
MHT score (standardised residuals)	-1.267 [-2.078, -0.455]	0.002	-1.144 [-2.407, 0.119]	0.076	-1.215 [-2.044, -0.387]	0.004
Years of full-time education	-0.506 [-0.798, -0.214]	< 0.001	-0.277 [-0.663, 0.109]	0.160	-0.352 [-0.648, -0.055]	0.020
Adult Occupational Social Class (reversed)	-0.969 [-1.876, -0.062]	0.036	-1.005 [-2.357, -0.347]	0.145	-1.742 [-2.635, -0.849]	< 0.001
Retirement age (years)	-0.088 [-0.223, 0.046]	0.199	-0.261 [-0.460, -0.062]	0.010	-0.140 [-0.275, -0.004]	0.043
Retirement type						
Voluntary (ref.)						
Ill Health	7.745 [5.426, 10.065]	< 0.001	10.358 [6.935, 13.780]	< 0.001	5.864 [3.526, 8.203]	< 0.001
Redundancy	3.835 [1.226, 6.443]	0.004	3.419 [0.078, 6.761]	0.045	1.394 [-1.236, 4.024]	0.298
Other	-1.115 [-3.831, 1.601]	0.420	1.189 [-2.648, 5.027]	0.543	-0.498 [-3.236, 2.240]	0.721

	Mental Health			
	HADS Anxiety scale score		HADS Depression scale score	
	B	p	B	p
Sex				
Male (ref.)				
Female	2.636 [0.523, 4.749]	0.015	1.108 [-1.055, 3.271]	0.314
Father's Occupational Social Class (reversed)	-0.164 [-1.349, 1.021]	0.786	-0.570 [-1.769, 0.628]	0.350
MHT score (standardised residuals)	-0.732 [-1.993, 0.528]	0.254	-0.659 [-1.943, 0.625]	0.313
Years of full-time education	-0.592 [-0.972, -0.211]	0.002	-0.229 [-0.620, 0.162]	0.250
Adult Occupational Social Class (reversed)	-0.179 [-1.510, 1.154]	0.792	-1.101 [-2.447, 0.246]	0.109
Retirement age (years)	-0.099 [-0.299, 0.101]	0.329	-0.124 [-0.327, 0.079]	0.232
Retirement type				
Voluntary (ref.)				
Ill Health	5.285 [1.786, 8.785]	0.003	5.315 [1.783, 8.847]	0.003
Redundancy	0.109 [-3.308, 3.525]	0.950	1.107 [-2.341, 4.556]	0.528
Other	1.712 [-2.212, 5.635]	0.391	-2.508 [-6.469, 1.452]	0.214

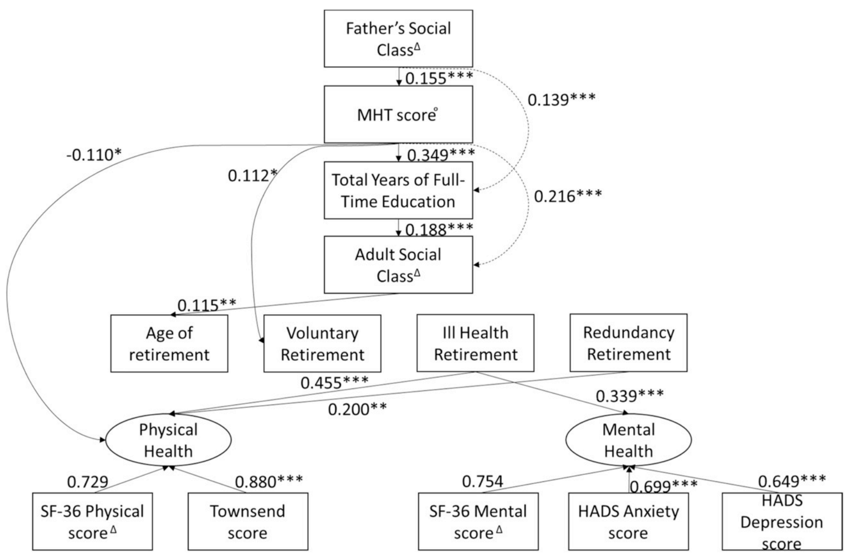

Fig. 3. Diagram showing the significant paths within the structural equation model. Not shown are arrows indicating covariance between retirement circumstances variables and between latent variables.
Δ = Reverse-coded variables. O = Standardised residuals from regression of MHT scores on age. MHT score = Moray House Test score (z-score); SF-36 = RAND Short-form 36-item Health Survey; HADS = Hospital Anxiety and Depression Scale. Physical Health $R^2 = 0.249$; Mental Health $R^2 = 0.153$.

ability (β = -0.110, 95% CI [-0.216, -0.004], p = 0.041). No other predictors were significantly associated with physical health (all ps > 0.356). Poorer mental health, on the other hand, was significantly predicted by retirement due to ill-health (β = 0.339, 95% CI [0.191, 0.486], p < 0.001) only (all other ps > 0.057).

Importantly, none of the indirect (mediated) associations between life-course predictors and physical or mental health were significant (all ps > 0.070; see Supplementary Material). Of particular note, the association between higher childhood cognitive ability and better physical health was not significantly mediated by education (p = 0.589), by adult social class (p = 0.680), by age of retirement (p = 0.599) or by any retirement type (all ps > 0.166). Furthermore, despite the significant association between adult social class and age of retirement, there was no significant mediated association between adult social class and either physical (p = 0.566) or mental (p = 0.887) health.

Discussion

The present study utilised the detailed early-life and later-life measures available in the 6-Day Sample and 36-Day Sample of the Scottish Mental Survey 1947 to investigate the nature and independence of the contribution of retirement circumstances (age and type) to post-retirement health. We observed independent contributions of retirement type (not age) and childhood cognitive ability to post-retirement health; whereas life-course factors did predict retirement circumstances there was no evidence of mediation. Furthermore, these contributions differed between physical and mental health outcomes.

Associations with retirement circumstances

Although not the focus of the present study, we observed a consistent and chronological association between life-course predictors themselves, in-line with work using the same sample (Iveson et al., accepted a; under review b). This supports the notion that poor childhood circumstances can have consequences for outcomes much later in life (Hayward & Gorman, 2004).

Among the life-course factors significantly associated with retirement circumstances, childhood cognitive ability and adult social class were the only ones to survive mutual-adjustment for other factors in the path model, with higher cognitive ability around age 11-years predicting higher odds of voluntary retirement and higher social class in adulthood predicting later retirement. The contribution of early-life cognitive ability may reflect its role in helping to build an individual's human capital (e.g., Becker, 1994; Sterns & Dawson, 2012; Iveson et al., accepted a) – the ability and skills necessary to continue working – thus supporting the ability to choose when to retire (rather than involuntary retirement due to ill-health or redundancy). Childhood cognitive ability did not, however, predict retirement age in the path model, suggesting that it does not play a consistent role in enabling earlier or later retirement, only the ability to retire when desired. Alternatively, advantage in childhood cognitive ability may help individuals to access occupations in which voluntary and statutory retirement is more likely (Deary et al., 2005). The association between higher adult social class and later retirement age likely represents the better opportunity to work beyond statutory retirement age among less manual occupations (McNair et al., 2004; Virtanen et al., 2017). Whereas more manual occupations are sensitive to age-related declines in physical health, less manual occupations allow individuals to continue working regardless of their health. Higher social class may also enable later retirement due to the better opportunities for further employment (rather than retirement) more suited to older age (McNair et al., 2004).

Associations with post-retirement health

Where previous studies have examined the contributions of either retirement age (e.g., Calvo et al., 2013; Di Gessa et al., 2017; Mein et al., 2003; Westerlund et al., 2010) or retirement type (e.g., Hyde et al., 2004; Jokela et al., 2010) to subsequent health, the present study concurrently examined their independent contributions to post-retirement health. Notably, age of retirement was not significantly associated with subsequent physical or mental health. Consistent with findings from the English Longitudinal Study of Ageing (Di Gessa et al., 2017), this suggests that delaying retirement does not benefit health once other factors are accounted for. Note, however, that we only measure age of full retirement; recent evidence from the Health and Retirement Study suggests that later, partial retirement may result in better functional health and slower decline in health in later life (Azar, Staudinger, Slachevsky, Madero-Cabib, & Calvo, 2019). Instead, retirement type proved a much stronger predictor of post-retirement health. Perhaps unsurprisingly, those who retired due to ill-health reported poorer physical and mental health later in life (Hyde et al., 2004; Jokela et al., 2010). This may reflect selection effects and the underlying contribution of proximal pre-retirement ill-health (Boissonneault & de Beer, 2018), however previous work has reported a significant association between ill-health retirement and poorer subsequent health even once baseline health has been accounted for (Hyde et al., 2004). The observed association between retirement due to redundancy and poorer post-retirement physical health may also be driven by poor pre-retirement health (Hyde et al., 2004), although redundancy has been observed to reduce wellbeing earlier in the life-course (Ferrie, 2001). In contrast to ill-health- and redundancy-related retirement, statutory and voluntary retirement was not significantly associated with post-retirement physical or mental health. This may be a result of the time gap between retirement and follow-up, as the health benefits of statutory and voluntary early retirement have been noted to diminish by around age 65 (Jokela et al., 2010). By age 77 (the first follow-up in the present sample) any health benefits of statutory and voluntary retirement may have disappeared but the health consequences of ill-health- and redundancy-related retirement seemingly remain.

In addition to considering retirement age and type separately, the present study reinforces the importance of pre-retirement life-course factors for post-retirement health (see Hyde et al., 2004). Higher childhood cognitive ability predicted post-retirement physical health but not mental health, when adjusted for other life-course factors and retirement circumstances. This is consistent with previous observations in an overlapping sample (Iveson et al., under review b), in which higher childhood cognitive ability predicted lower odds of reporting a function-limiting condition across later life. The observed contribution of higher cognitive ability to later-life physical health also supports its suggested role in encouraging healthy behaviours and building resilience to morbidity (Hagger-Johnson et al., 2010; Stern, 2009). In the present study, no other life-course factor significantly predicted post-retirement health once adjusted for other life-course factors and retirement circumstances. This indicates that the contribution of factors such as education and adult social class, two of the most-cited predictors of post-retirement health (e.g., Hyde et al., 2004; Smith et al., 2015), may be better explained by confounded life-course predictors such as childhood cognitive ability.

There was little evidence that retirement age or retirement reason mediated the association between life-course factors and later-life health. This indicates that the often-observed association between early-life circumstances and later-life health (e.g., Iveson et al., under review b; Hagger-Johnson et al., 2010; Smith et al., 2015) cannot be simply explained by more advantaged individuals achieving more positive retirement circumstances. However, given the modest sample size of the present study, the lack of any mediation effects should be interpreted with caution. Replication in a larger sample is necessary, although we acknowledge that finding a sample with all the required data is difficult. Furthermore, the present study did not have the power to assess potential moderation effects. There is some evidence, for example, that the contribution of retirement type differs between different occupational social classes (e.g., Jokela et al., 2010; Mein et al., 2003; Westerlund et al., 2009) and that the paths between life-course factors, retirement circumstances, and subsequent health may differ between males and females (e.g.,Hatch et al., 2007; Jokela et al., 2010) and between levels of educational attainment (e.g., Shaw & Spokane, 2008).

Limitations

The generalisability of the present study is somewhat limited by its choice of sample. In particular, the individuals included here – all born in 1936 and residing in Scotland in 1947 – lived through the Second World War (and its aftermath) as well as significant changes to the educational system and labour market. More modern cohorts likely experience very different socioeconomic (e.g., different types of occupation), educational (e.g., longer schooling) and retirement (e.g., higher statutory retirement age) circumstances which may impact upon the pattern and strength of associations observed with later-life health. However, cognitive ability (Hatch et al., 2007), ill-health retirement (Jokela et al., 2010) and redundancy retirement (Hyde et al., 2004) have all been shown to predict later-life health in younger cohorts, albeit not together and not adjusted for other factors as is the case here.

Furthermore, as with many studies of retirement circumstances, the present study is limited by sample selection effects. Only 47% of the original sample were available for follow-up, and of those who responded only 55% provided retirement status. The individuals who were removed due to death prior to follow-up, being untraceable at follow-up, or non-response generally exhibited lower childhood cognitive ability and lower childhood social class. Disadvantage in these variables has been associated with higher mortality risk (Iveson, Čukić, Der, Batty, & Deary, 2017) and poorer health in mid-life (Hart et al., 2003). As such, the retained sample likely represents the healthiest individuals who have survived up to retirement age. This also means that we likely underestimate the frequency and proportion of 'negative' retirement circumstances, such as ill-health retirement, as well as the associations between life-course factors and retirement circumstances. This issue can perhaps be best solved through population record linkage, capturing the entire life-course of transitions out of the workforce and mortality for all individuals without the need for active follow-up.

Conclusion

The present study suggests that retirement circumstances do contribute to post-retirement health, albeit in a limited way, and that this contribution differs between physical and mental health. Poorer post-retirement health, especially physical health, is better predicted by retirement due to ill-health and redundancy than the age at which an individual retires. The present study also demonstrates that retirement circumstances are not alone in their contribution to post-retirement health; higher cognitive ability in childhood independently predicted better physical health after retirement. There was no evidence that retirement circumstances mediated the associations between life-course predictors and post-retirement health. The present study highlights the importance of considering the complexity of retirement circumstances alongside earlier pre-retirement factors when examining the impact of retirement on health.

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Conflict of interest statement

We declare no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Ethics statement

This submission is covered by the ethics application "Lifelong health and wellbeing of the 'Scotland in Miniature' cohort: The 6-Day Sample of the Scottish Mental Survey" (REC# 12/SS/0024; Scotland A Research Ethics Committee).

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ssmph.2019.100430.

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